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Efficacy of Injectable Ivermectin against Ascaris suum of Swine in Jimma University College of Agriculture and Veterinary Medicine and Missionary of Charity Swine Farms in Jimma Town, Southwestern Ethiopia

Daba Gudeta Guder[1] Minda Asfaw Geresu[2]
1.Chilalo University College, Veterinary Clinical Services Department, Asella, Ethiopia
2.Animal and Range Sciences Course Team, School of Agriculture, Madda Walabu University, Bale-Robe, Ethiopia

Abstract
An experimental study was carried out from November, 2008 to February, 2009 on two swine farms (College of Agriculture and Veterinary Medicine and Missionary of Charity swine farms) in Jimma town, South western Ethiopia with the objective of evaluating the efficacy of injectable ivermectin against *Ascaris suum* (*A.suum*) (Swine ascariasis). The method of measurement for efficacy was fecal egg count percentage reduction (%FECR) and the mean body weight gain. The trial was conducted on 42 naturally infected pig with *A. suum*. The animals were screened for ascariasis and positive animals with EPG of greater or equal to 100 were weighed and randomly selected and grouped into treatment group and control group were included under the trial. The fecal examination was carried out to determine EPG level in both groups. Inaddition, the body weight of each animal in the experimental group was measured. The mean EPG of treatment and control group pretreatment was 74.49 and 73.96, respectively while the mean body weight of the treatment and control group before treatment was 402.380 and 397.619, respectively. The treatment group were treated with injectable ivermectin subcutaneously with the dose rate of 0.3mg/kg. At the 7th day and 14th day posttreatment fecal examination was again carried out and the level of EPG in the treatment group was significantly reduced compared to that of control group. The mean EPG during week 1 and week 2 after treatment was 107.143 and 7.142 for treatment group and 397.619 and 390.47 for control group, respectively. This difference was statistically significant ($P<0.001$) as revealed by ANOVA results. The mean body weight for the treatment group and control group after treatment was 80.71 and 77.33, respectively. This difference in mean body weight gain between the teartment and control group was stastisticallly insignificant ($P>0.05$). Eventhough the difference in mean body weight gain between the teartment and control group after treatment is not statistically significant, the rusult of FEC showed that, injectable ivermectin is effective for treatment of *A.suum* in swine. Therefore, further detailed investigations are needed to evaluate the efficacy of ivermectin to control *A.suum* of pig in piggery farms of Ethiopia.
Keywords. Efficacy, Ivermectin., Swine, *A.suum*, Jimma, Ethiopia

1. Introduction

The sustainable development of the swine industry is faced with a number of constraints among which are the diseases caused by intestinal parasites (Aliaga-Leyton *et al.*, 2011). Gastrointestinal parasites are responsible for substantial loss of productivity in swine and other livestock industry. They constitute a major impediment to efficient and profitable livestock production (Boes *et al.,* 2000*;* Joachim *et al.*, 2001). Gastrointestinal parasitism in swine affects swine's performance in terms of efficient feed conversion, poor growth rate, reduced weight gain and the condemnation of affected organs after slaughter causing economic losses in pork industry (Nsoso *et al.*, 2000; Tomass *et al*., 2013; Bernard *et al*., 2015).

Several studies have been conducted to determine the occurrence and economic importance of parasites in pigs and various parasite species have been identified worldwide. These studies have identified *Ascaris* spp., *Trichuris* spp., *Oesophagostomum* spp., *Trichinella* spp., *Strongylus* spp. (Caballero-Hernández *et al.* 2004; Kagira *et al.* 2008), *Eimeria* spp., *Isospora* spp. and *Cryptosporidium* spp. (Nosal and Eckert, 2005) as the most common gastrointestinal parasites of pigs.

In Ethiopia, very few publications are available focusing on pig gastrointestinal parasites. In a study conducted among 714 pigs by Tomass *et al.* (2013) for gastrointestinal parasites in extensively managed pigs in Mekelle and urban areas of southern zone of Tigray region, four species of parasites were implicated including *A. suum*, *F. hepatica*, *Eimeria* spp. and *T. suis*. Study conducted among 388 pigs for parasitic interaction in and around Holetta by Abdu and Gashaw (2010), reported three gastrointestinal parasites infection with *A.suum* the most prevalent (13.9%). Recently, Kumsa and Kifle (2014) reported 13.2% of pigs were infected with one or more types of parasite in Burayu district of Oromia Regional State while Jufare *et al.* (2015) reported four gastrointestinal parasites in two farms with poor husbandry practices in Bishoftu with the highest prevalence of *Coccidia* spp. In addition to this, Geresu *et al*. (2015) reported six gastrointestinal parasites in pigs slaughtered at

Addis Ababa Abattoirs Enterprise originating from Bishoftu and Addis Ababa surroundings with *Strongyloides* spp. the most prevalent (16.2%) followed by *A.suum* (12.6%).

Among the gastrointestinal parasites reported, *A. suum* causes possible health risk following human infection. It has been reported that *A. suum* is among the causes of visceral larva migrans in humans (Sakakibara *et al*., 2002). In addition, human cases with liver and lung lesions as well as cases and epidemics of eosinophilia pneumonia have been reported and *A. suum* specific antibodies were positive in all the cases (Arimura *et al.*, 2001; Kakihara *et al*., 2004). In addition to public health importance, *A.suum* causes damage to the host in terms of nutritional deficiency, morbidity and economic loss (Chavhan *et al*., 2009). Hence, to overcome this serious problem in pig's treatment with doramectin and ivermectin (IVM) (Lichtensteiger *et al*., 1999), doramectin (Stewart *et al*., 1996) against *Ascaris suum* infection, are followed.

Ivermectin (IVM) is antiparasitic drug derived from the avermectin family of potent, broad spectrum isolated from fermentation of *stryptomyces avermitilis*. In swine, IVM injection is formulated to deliver the recommended dose level of 300mcg ivermectin/Kg body weight given subcutaneously in the neck at the rate of 1ml/75lb (33kg) (Campbell *et al.*, 1983). Since IVM was introduced into the market, it has been demonstrated in many reports that it possessed excellent activity against the common endoparasites of swine such as *A.suum* and *Oesophagostomum* spp. (Borgsteede *et al*., 2007). At present, this is still the case and fortunately, unlike the situation in sheep, there are no clearly demonstrated cases of resistance of swine parasites to IVM, although it was suggested that IVM showed a poor efficacy against a laboratory isolate of *Oesophagostomum quadrispinulatum* (Dangolla, 1994). Later studies with this strain demonstrated that this was not because of resistance (Varady *et al.,* 1996).

Eventhough swine farm is not commonly practiced in Ethiopia because of socio-cultural and religious factors; different anthelminthics are on the use by a few swine farmers for treatment of gastrointestinal helminthes including ascariasis. However, use of ivermectin against swine ascariasis is not commonly practiced probably due to lack of information concerning efficacy of the drug against *A. suum* in the country. To our knowledge, there is no published information detailing the efficacy of injectable ivermectin against pigs infected with *A.suum*. Hence, the aim of the present study was to evaluate the efficacy of injectable IVM in pigs infected with *A. suum.*

2. Materials and Methods

Study Area

The study was conducted in Jmma town of Oromia Regional State, south-western Ethiopia. The study area, Jimma city is located at 355km south-western of Addis Ababa. The area lies between a latitude of 7°41'N and longitude of 36°50'E and has an elevation of 1704 meters above sea level. The area is characterized by a humid tropical climate of heavy annual rainfall that ranges from 1200-2000 mm per year. About 70% of the total annual rainfall is received during rainy season, which lasts from the end of May to early September. The mean annual maximum and minimum temperature ranges from 25°C-30°C and 7°C-12°C (OPEDJZ, 2002).

The study was conducted from November, 2008 to February, 2009 at two swine farms in Jimma town, Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) swine farm and at Missionary of Charity swine farm in Jimma town, south western Ethiopia. The two swine farms are located at opposite ends of the town, missionary of charity swine farm being at the eastern and that of JUCAVM at the western extremity of the town.

Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) swine farm is established in 1990 in JUCAVM campus under animal science department. The purpose of the farm is for academic as well as for supply of the live as source of meat mostly for foreigners. The animals are fed with grasses harvested from the campus. Additionally they are also given leftovers from students' cafeteria and sometimes grains like corns depending on availability. The number of animals in the farm is maintained at constant level (usually 30 animals at time) to fit with the farm's holding capacity. The number of animals is regulated by selling the growing piglets keeping the adults for breeding purpose. But, currently there are only 10 animals kept in the farm due to scarcity of food. Missionary of charity swine farm is established in 2004 by Non Governmental Organization (NGO) called Missionary of charity under the administration of Chatholic church of Jimma town district. However, originally, the pigs in the farm were brought from JUCAVM swine farm. The farm contained total of 43 animals. The pigs are fed on the concentrates which is purchased from the market and usually prepared as mixture of grains like corn, wheat and barley.

The study animals and design

The study animals are swine. First, all the animals in both farms were screened for ascariasis by fecal examination. A total of 42 naturally infected pigs with *A. suum* and with a mean EPG of greater or equal to 100 were selected from both farms and included under the study. Thirty three (33) and 9 animals were included under the trial from Missionary of Charity and JUCAVM, respectively. The effect of anthelminthic treatment was

estimated based on analysis of measurements on *Ascaris* egg count reduction and live body weight gain.
The fecal examinations were carried out at days, day 0, day7 and day 14. The live body weight measurements were carried out at days, day 0, day14, day 28, day 42 and day 56. The farm managers from both farms were informed and the experimental animals were not sold or slaughtered until the end of the trial.
The FECRT was calculated according to the procedure described by;

$$FECRT\% = \frac{(T1-T2)\ x100}{T1}$$

Where T1-mean EPG pre-treatment
T2-Meam EPG post treatment
According to (Alva-Valdez *et al*., 1989) resistance is declared if only one of the following criteria is met.
1 The percentage reduction in egg count is less than 95% or
2 The 95% confidence level is less than 90%.

Data analysis
All the raw data's that were recorded from the experiment were entered into Microsoft excel database system and analyzed. The EPG between the two groups were tested using one way functional analysis variance (ANOVA). Reduction in infection rate between the two groups was compared by chi-square. In all the analyses confidence level was held at 95%.

3. Results
Mean egg per gram (EPG) in experimental pigs
The parasitological data revealed that the mean EPG of *A.suum* infestation rate in the animals treated with injectable ivermectin was reduced dramatically with the increment of the day while in the control group the reduction rate was insignificant as depicted in Table 1.
Table 1: *Ascaris suum* infestation rate before and after treatment in both treatment and control groups.

Day	Mean EPG in experimental pigs	
	Treated group	Control group
Day 0	402.380	397.619
Day 7	107.143	397.619
Day 14	7.142	390.476

Pr =0.001, Pr=Precision value

Measurement of body weight of the study animals
The body weight of each animal in treatment and control group was taken five times at two weeks interval starting from day 0 (day of treatment) through day 14, 28, 42, and 56 after treatment.
Table 2: Mean body weight in treatment and control group before and after treatment

Days of measurement	Mean body weight of experimental group in kg	
	Treated group	Control group
Day0	74.49	73.96
Day 14	75.71	72.81
Day 28	77.29	75.45
Day 42	78.76	75.90
Day 56	80.71	77.33

Mean eggs per gram (EPG) and percentage reduction of *Ascaris suum* eggs in experimental pigs
The fecal examination during the second week post treatment showed that there was significant reduction in eggs per gram (EPG) in the treatment group and the level of infection in the control group is almost the same before and after treatment (Table 3).
Table.3: Mean eggs per gram (EPG) and percentage reduction of eggs treated with injectable ivermectin (0.3 mg/kg body weight) subcutaneously

Group	Mean EPG		Percentage reduction in FEC (FECR %)
	Pretreatment	Post treatment	
Treated	402.380	7.142	99.9%
Control	397.619	390.476	1.8%

Pr =0.001, Pr=Precision value

Mean body weight and percentage of weight gain of Pigs before and after treatment

The result of body weight measurement showed that as there was no significant difference between the treatment and control group in mean body weight gain. The mean body weight of the treated group were 74.49 and 80.71 kg before the treatment and after the treatment, respectively, while the mean body weights of control group were 73.96 and 77.33 kg before the treatment and after the treatment (Table 4).

Table 4: Mean body weight and percentage of weight gain before and after treatment in treatment and control group.

Group	Mean body weight (in kg.)		% of mean body weight gain
	Pretreatment	Post treatment	
Treated	74.49	80.71	8.35
Control	73.96	77.33	4.56

Pr>0.05, Pr=Precision value

The following graph has shown the mean body weight of experimental animals at each day of measurement before and after treatment.

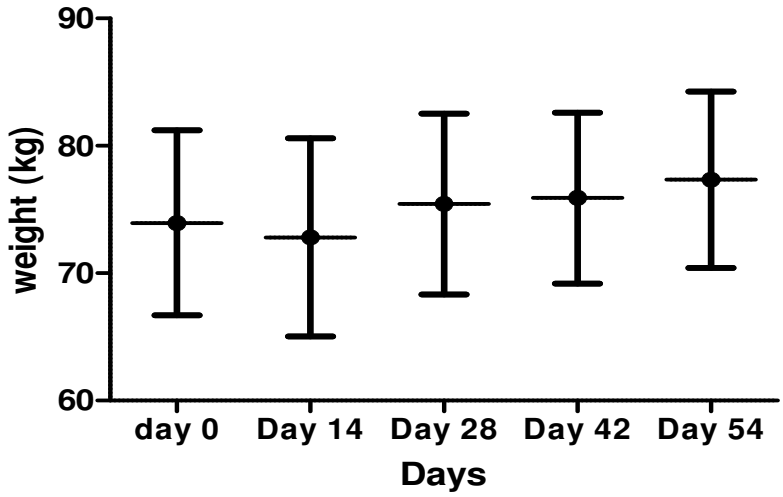

Figure 1: weight gains of the control group

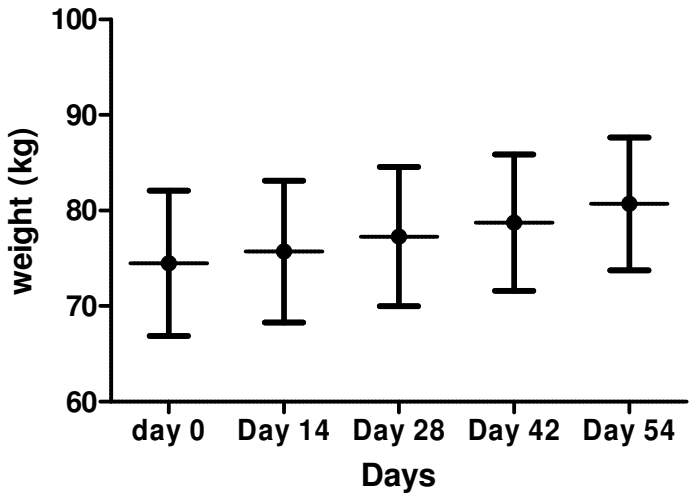

Figure 2: weight gains of the treatment group

Effect of treatment on EPG and mean body weight gain

Result of the effect of anthelminthic treatment on EPG in pigs involved in the treatment trial was depicted in Table 3.

4. Discussion

The result of this experiment revealed that injectable ivermectin is effective against swine ascariasis (*A. suum*). The parasitological data indicated that the mean EPG of *A.suum* infestation rate in the animals treated with injectable ivermectin was reduced dramatically on the second week of post treatment. After 14 days of treatment, the mean EPG of *A.suum* in experimental pigs was 7.142. This finding is in contrary with the earlier reports of Chavhan *et al*. (2009) in Tumsar dist-Bhandara in which all feacal samples were negative after two weeks of the treatment.

The effect of injectable ivermectin on mean body weight gain in this trial was insignificant. The mean body weight of experimental pigs was 74.49 and 73.96 in the treatment and control group, respectively on the day 0 (day of treatment). The mean body weight gain difference observed between the treated and controlled group of pig was insignificant (P>0.05). This result was in contrary with the work of Gutierres *et al.* (1990) in which the effect of in feed ivermectin significantly associated with the improvement of body weight, food conversion efficiency and performance of growing pigs. The reason that the treatment and control group showed similarity in mean body weight gain after treatment in this trial was the age of the animals that were involved in the trial was high and there is slow growth rate compared to that of younger animals. Hence, the effect of treatment can be more observed through reduction in fecal egg count reduction.

In this experiment, the mean EPG value of *A.suum* in both treatment and control group was 402.380 and 397.619 pretreatment, respectively. However, the mean EPG during the first and second week post treatment in treated and controlled group was 7.142 and 390.476, respectively. This revealed as there was significant difference (P<0.001) in mean EPG value between the two groups after treatment. Several literatures also revealed strong efficacy of ivermectin in different species of gastrointestinal nematodes. According to Lichtensteiger *et al*. (1999) persistent activity of ivermectin against experimentally induced infection of *A.suum* in swine is significantly high since nematode count is highly reduced which strongly agrees with this experimental study.

The mean body weight and percentage of weight gain before and after treatment in the treated (8.35%) and control (4.56%) group of pigs revealed that as there was no significant difference in body weight gain between treatment and control group after treatment (P>0.05). In addition to this, figure (1 and 2) has shown that as there was slight difference in mean body weight gain in the treatment group compared to the control group even though the difference is statistically insignificant(P>0.05).

5. List of Abbreviations

FECR	fecal egg count percentage reduction
EPG	Egg per gram
ANOVA	Analysis Of Variance
JUCAVM	Jimma University College of Agriculture and Veterinary Medicine
IVM	Ivermectin
NGO	Non Governmental Organization

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